

Amendments to the Claims

Please cancel Claims 1-19. Please add new Claims 20-40. The Claim Listing below will replace all prior versions of the claims in the application:

Claim Listing

1-19 Cancelled

²¹
~~20.~~

(New) A proton-conducting polymer membrane which is based on polyvinylsulphonic acid and is obtained by a process comprising the steps of:

- a) mixing a polymer with a vinyl-containing sulphonic acid,
- b) forming a flat structure using the mixture from step a) on a support,
- c) polymerizing the vinyl-containing sulphonic acid present in the flat structure from step b),

characterized in that the membrane has an intrinsic conductivity of at least 0.001 S/cm.

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21.

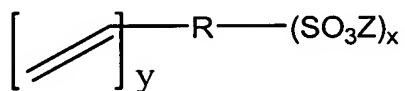
(New) The membrane of Claim 20, characterized in that the polymer used in step a) is a high-temperature-stable polymer containing at least one nitrogen, oxygen, or sulphur atom in one repeating unit or in different repeating units.

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(New) The membrane of Claim 20, characterized in that one or more polyazoles and/or polysulphones are used in step a).

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23.

(New) The membrane of Claim 20, characterized in that the mixture prepared in step a) contains compounds of the formula



where

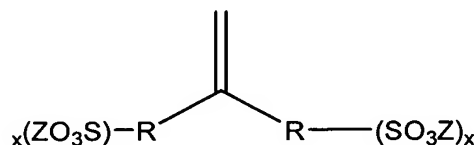
R is a bond, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radications optionally substituted by halogen, -OH, COOZ, -CN, or NZ₂,

Z are each, independently of one another, hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, -CN,

x is 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10, and

y is 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10, or

the formula



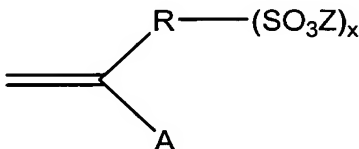
where

R is a bond, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, COOZ, -CN, NZ,,

Z are each, independently of one another, hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, -CN, and

x is 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10, or

the formula



where

A is a group of the formula COOR^2 , CN , CONR_2^2 , OR^2 , or R^2 , where R^2 is hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, $-\text{OH}$, COOZ , $-\text{CN}$, NZ ,

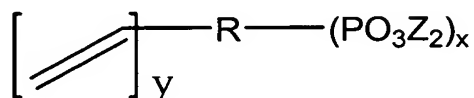
R is a bond, a divalent C1-C15 alkylene group, divalent C1-C15 alkylenoxy group, with the above radicals optionally substituted by halogen, -OH, COOZ, -CN, NZ,

Z are each, independently of one another, hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, -CN, and

x is 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10.

²⁵
24. (New) The membrane of Claim 20, characterized in that the mixture prepared in step a) comprises vinyl-containing phosphonic acid.

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25. (New) The membrane of Claim 24, characterized in that the mixture prepared in step a) contains compounds of the formula



where

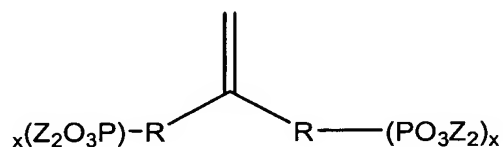
R is a bond, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, COOZ, -CN, NZ₂,

Z are each, independently of one another, hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, -CN,

x is 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10, and

y is 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10, or

the formula



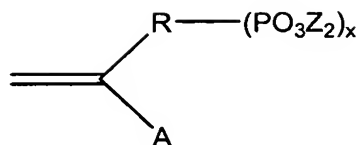
where

R is a bond, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, COOZ, -CN, NZ₂,

Z are each, independently of one another, hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, -CN, and

x is 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10, or

the formula



where

- A is a group of the formula COOR^2 , CN , CONR_2^2 , OR^2 , or R^2 , where R^2 is hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group, or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, $-\text{OH}$, COOZ , $-\text{CN}$, NZ_2 ,
- R is a bond, a divalent C1-C15 alkylene group, divalent C1-C15 alkyleneoxy group, with the above radicals optionally substituted by halogen, $-\text{OH}$, COOZ , $-\text{CN}$, NZ_2 ,
- Z are each, independently of one another, hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, $-\text{OH}$, $-\text{CN}$, and
- x is 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10.

²⁷
26. (New) The membrane of Claim 24, characterized in that the weight ratio of vinyl-containing phosphonic acid to vinyl-containing sulphonic acid is in the range from 1:100 to 99:1.

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27. (New) The membrane of Claim 20, characterized in that the mixture prepared in step a) contains monomers capable of crosslinking.

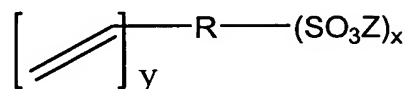
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28. (New) The membrane of Claim 20, characterized in that the polymerization in step c) is effected by means of a substance which is capable of forming free radicals.

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29. (New) The membrane of Claim 20, characterized in that the polymerization in step c) is carried out by irradiation with IR light, NIR light, UV light, β -rays, γ -rays, or electron beams.

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30. (New) The membrane of Claim 20, characterized in that the membrane comprises from 1 to 90% by weight of the polymer and from 99 to 0.5% by weight of polyvinylsulphonic acid.

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31. (New) The membrane of Claim 20, characterized in that the membrane has a layer comprising a catalytically active component.

³³
32. (New) A mixture comprising:
a vinyl-containing sulphonic acid having the formula



where

R is a bond, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicalations optionally substituted by halogen, -OH, COOZ, -CN, or NZ₂,

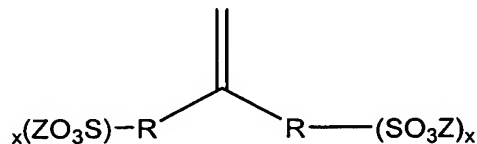
Z are each, independently of one another, hydrogen, a C1-C15 alkyl group,

C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, -CN,

x is 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10, and

y is 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10, or

the formula

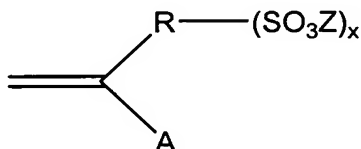


where

R is a bond, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, COOZ, -CN, NZ₂,

Z are each, independently of one another, hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, -CN, and

x is 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10, or the formula



where

A is a group of the formula COOR^2 , CN, CONR_2 , OR^2 , or R^2 , where R^2 is hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, COOZ , -CN, NZ_2 ,

R is a bond, a divalent C1-C15 alkylene group, divalent C1-C15 alkyleneoxy group, with the above radicals optionally substituted by halogen, -OH, COOZ , -CN, NZ_2 ,

Z are each, independently of one another, hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, -CN, and

x is 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10; and

at least one polymer which has a solubility of at least 1% by weight in the vinyl-containing sulphonic acid.

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33.

(New) The mixture of Claim 32, characterized in that the polymer used contains at least one nitrogen, oxygen, or sulphur atom in one repeating unit or in different repeating units.

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(New) The mixture of Claim 32, characterized in that it contains at least one monomer capable of crosslinking.

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35. (New) The mixture of Claim 32, characterized in that it contains at least one initiator which is capable of forming free radicals.

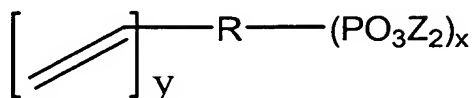
³⁷
36. (New) The mixture of Claim 32, characterized in that the mixture comprises at least one vinyl-containing phosphonic acid.

³⁸
37. (New) A membrane-electrode unit containing at least proton-conducting polymer membrane which is based on polyvinylsulphonic acid and is obtained by a process comprising the steps of:

- a) mixing a polymer with a vinyl-containing sulphonic acid,
- b) forming a flat structure using the mixture from step a) on a support,
- c) polymerizing the vinyl-containing sulphonic acid present in the flat structure from step b),

characterized in that the membrane has an intrinsic conductivity of at least 0.001 S/cm.

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38. (New) The unit of Claim 37, characterized in that the mixture prepared in step a) contains compounds of the formula



where

R is a bond, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, COOZ, -CN, NZ₂,

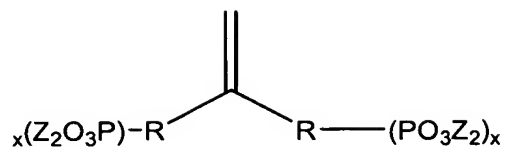
Z are each, independently of one another, hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, -CN,

x is 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10, and

y is 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10, or

the formula

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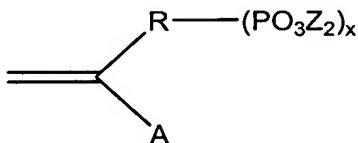
where

R is a bond, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, COOZ, -CN, NZ₂,

Z are each, independently of one another, hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, -CN, and

x is 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10, or

the formula



where

A is a group of the formula COOR², CN, CONR², OR², or R², where R² is hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group, or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, COOZ, -CN, NZ₂,

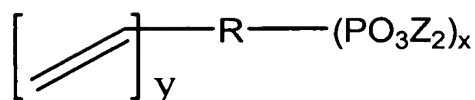
R is a bond, a divalent C1-C15 alkylene group, divalent C1-C15 alkyleneoxy group, with the above radicals optionally substituted by halogen, -OH, COOZ, -CN, NZ₂,

Z are each, independently of one another, hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, -CN, and

x is 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10.

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39.

(New) The unit of Claim 37, characterized in that the mixture prepared in step a) contains compounds of the formula



where

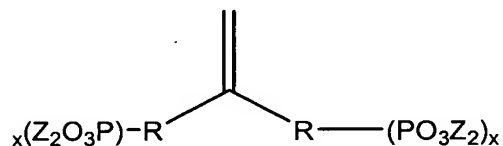
R is a bond, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, COOZ, -CN, NZ₂,

Z are each, independently of one another, hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, -CN,

x is 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10, and

y is 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10, or

the formula



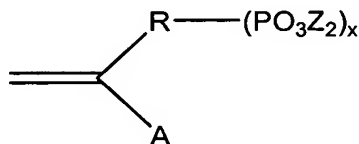
where

R is a bond, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, COOZ, -CN, NZ₂,

Z are each, independently of one another, hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, -CN, and

x is 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10, or

the formula



where

A is a group of the formula COOR², CN, CONR², OR², or R², where R² is hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethylenoxy group, or

- C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, COOZ, -CN, NZ₂,
- R is a bond, a divalent C1-C15 alkylene group, divalent C1-C15 alkyleneoxy group, with the above radicals optionally substituted by halogen, -OH, COOZ, -CN, NZ₂,
- Z are each, independently of one another, hydrogen, a C1-C15 alkyl group, C1-C15 alkoxy group, ethyleneoxy group or C5-C20 aryl or heteroaryl group, with the above radicals optionally substituted by halogen, -OH, -CN, and
- x is 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10.

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40.

(New) A fuel cell containing:

one or more membrane-electrode units containing at least one proton-conducting polymer membrane which is based on polyvinylsulphonic acid and is obtained by a process comprising the steps of:

- a) mixing a polymer with a vinyl-containing sulphonic acid,
- b) forming a flat structure using the mixture from step a) on a support,
- c) polymerizing the vinyl-containing sulphonic acid present in the flat structure from step b),

characterized in that the membrane has an intrinsic conductivity of at least 0.001 S/cm, or

one or more of the proton-conducting polymer membranes.